



## Original communication

## Perceptions of near virtual autopsies

Guy N. Ruty MBE, MBBS, MD, FRCPath, DipRCPPath(Forensic), FFFLM, FSSoc,  
Professor of Forensic Pathology<sup>a,\*</sup>, Jane E. Ruty PhD, RGN, FHEA, Principal Lecturer<sup>b</sup>

<sup>a</sup> East Midlands Forensic Pathology Unit, Leicester Royal Infirmary, Leicester LE2 7LX, UK

<sup>b</sup> School of Nursing and Midwifery, De Montfort University, Leicester, UK

## ARTICLE INFO

## Article history:

Received 9 December 2010

Received in revised form

17 May 2011

Accepted 15 June 2011

Available online 7 July 2011

## Keywords:

Autopsy

Post-mortem

Near virtual autopsy

Computed tomography

Pathologist

Public

Perception

## ABSTRACT

**Introduction:** We present for the first time to our knowledge an insight into pathology/medico-legal practitioners' and general public perceptions' of the use of computed tomography (CT) scanning as an alternative to the invasive autopsy.

**Subjects:** The study arises from questionnaires at two professional meetings before and after an informative talk on the current use of CT in medico-legal autopsy practice. A total of 45 general public and 27 pathologists/medico-legal practitioners completed both parts of the study. A combination of open and closed questions were used to allow thematic and descriptive statistical analysis.

**Results/conclusions:** The results show commonalities and differences of opinions between the two study groups. A desire was identified from the public to use CT scanning as an alternative to invasive autopsy if available. However, the majority of the public questioned indicated that they would not object to an invasive autopsy being undertaken on their relative if one was authorised by a coroner; it was the pathologists who questioned the need for the examination. However, although they raised this question, the pathologists still expressed the preference of the traditional invasive autopsy over a CT scan.

© 2011 Elsevier Ltd and Faculty of Forensic and Legal Medicine. All rights reserved.

## 1. Introduction

There is a general perception that the general public and religious faiths find the thought of their recently deceased loved one being subjected to an invasive autopsy distasteful. However this may not be based on an understanding of actual public perceptions and faith beliefs themselves but may in fact reflect the personal perceptions of the individual expressing them. For example, of the major faiths, Hinduism dislikes but does not forbid autopsies whereas Islam, Judaism and Zoroastrian do not permit autopsy examination within their faith unless ordered by the coroner.<sup>1</sup> These perceptions have in part driven the medical profession over the years to seek an alternative to the invasive autopsy. This has included the use of view and grant systems, needle biopsy, laparoscopic, endoscopic and toxicological autopsies.<sup>2</sup> However, despite the promotion and availability of these systems, the invasive autopsy remains in use to date as the principle mode of examination of the dead.

In recent times interest has grown across the world into the possibility of the use of multi detector computed tomography (CT)

as an adjunct or alternative to the invasive autopsy. Although, to the authors knowledge, CT was first reported in autopsy practice in 1983,<sup>3</sup> with the first published proposal to its use as an alternative to the invasive autopsy in 1994,<sup>4</sup> over the last 27 years the pathology profession has been slow to take up both of these concepts. This in part is due to time related technical developments of CT. It has not been until the introduction of multi-detector computed tomography (MDCT) into clinical practice that the full potential of CT became apparent and available for consideration within autopsy practice.<sup>5–7</sup>

The use of post-mortem computed tomography (PMCT) is now gaining increased interest within the United Kingdom (UK). However, before its widespread introduction into autopsy practice or its introduction as a realistic alternative to the invasive autopsy, there are many hurdles to overcome, not least those related to logistics, cost and training of personnel.<sup>8</sup> Assuming that it is accepted that PMCT offers an equivalent to the invasive autopsy in certain circumstances, the question is, will the general public and pathologists accept its use instead of the current system? In addition to this, will the end user i.e. the judiciary and police be able to use the results in the same way as they do as a report generated from an invasive examination?

We present the results of a survey based research study of two populations intending to gauge their perceptions related to the use

\* Corresponding author. Tel.: +44 116 252 3221; fax: +44 116 252 3274.

E-mail address: [gnr3@le.ac.uk](mailto:gnr3@le.ac.uk) (G.N. Ruty).

of PMCT as an alternative to an invasive autopsy. To our knowledge this is the first such work undertaken in the UK to consider this issue. We present the findings related to a cohort of the general public and compare it to a cohort of pathologists/medico-legal practitioners. With this knowledge one can gain an insight into areas of acceptance and disagreement with the use PMCT as an alternative to the invasive autopsy, an insight which one needs to know prior to future service development.

## 2. Method and materials

Author GR was invited to give two talks in 2010 based on the East Midlands Forensic Pathology's 8 year experience in the use of PMCT with coroner's autopsies (both so-called "routine" and "forensic" cases); the first was the 2010 Presidents lecture to the British Institute of Non Destructive Testing (BINDT) (considered as general members of the public) and the second as part of an educational day concerning the coroner's autopsy, hosted by the Royal College of Pathologists. Both talks subject matter concerned the so-called 'near virtual autopsy' and contained the same core subject matter. The areas covered by the talks were:

- A historical review of the role of radiology in autopsy practice
- A review of legislations related to autopsy practice
- A historical review of the use of CT in medico-legal and autopsy practice
- A review of the current role of CT in autopsy practice within the areas of:
  - Identification
  - Where the person died
  - When they died
  - How they died:
- Natural death
- Unnatural death
- The role of angiography with cadaveric CT
- An overview of logistics and cost of cadaveric CT

A comparative survey that collected data using questionnaires comprising of a combination of open and closed questions was undertaken at both talks on a convenient sample. The talk attendees were invited to complete questionnaires which had been designed to capture their perceptions as to the role of CT in autopsy practice prior to and after the talks. By using two questionnaires it was possible to gauge whether or not the content of the talk altered the views of the participants. Not all those who attended the talks participated in the survey. Those who choose to participate were provided with information as to the purpose of the survey and written consent was acquired for their participation. All questionnaires were made anonymous by use of a unique code. The questionnaires were tested prior to use with the same pre and post questionnaires used at both talks. To ensure conformability and transferability overall the participants came from a range of gender, occupations, religious and geographical locations and completed the questionnaires without opportunity to discuss the questions with other participants. The responses were analysed by qualitative thematic and quantitative descriptive analysis. Where participants had not completed both a pre and post talk questionnaire, the participant's questionnaire was excluded from the analysis.

## 3. Results

The results provided are related to the two different groups at each meeting. The numbers of responders are expressed as

a percentage of the total sample size. Non-responders for any one particular question make the difference up to 100%.

### 3.1. General public

A total of 48 non-medical members of the public participated in the questionnaire undertaken at the BINDT meeting. Three were excluded due to failure of completion of both parts leaving a sample size of 45 participants. Of these 90% were male from a science background, with the principle religion stated as being Christian (47%). Only 4 had previous experience of an autopsy or the coroners system through personal family bereavement.

When asked how they would rank their reaction to the thought of an autopsy being undertaken on a relative 56% answered that they would accept this without question, 13% would be unhappy but would accept the decision, 20% would question the need for it to be done, and 7% would object to the decision.

When asked whether they would object to an autopsy, if they could, even if the decision might go against them, 38% said "yes" and 53% said "no". They were then asked, if a CT scan was available as an alternative to an invasive autopsy whether they would prefer the scan over the autopsy prior to the informative talk 89% responded that they would prefer the CT scan although following the talk this was reduced to 80%.

When asked if they would be prepared to bear the costs of the scan which currently can be upwards to £1000, prior to the talk 20% replied "yes" with 58% answering "no" but after the talk 47% replied "yes" and 49% answered "no". The increase in those answering "yes" reflected the difference between the non-responders to the question before the talk (22%) and after the talk (4%). They were then asked if it was reasonable that the cost of the scan fell to the relatives to which 22% responded "yes" and 78% answered "no".

When asked if an invasive autopsy provided "a" cause or "the" cause of death 40% replied "a" and 22% responded "the" with 38% not answering. When further asked if the exact cause of death was important to them 27% said "yes" and 38% replied "no". Finally in this section, when asked if a CT scan could provide "a" cause of death but not necessarily "the" cause of death would they prefer an autopsy or CT scan 44% said autopsy and 47% replied CT scan prior to the talk but this changed to 20% and 76% respectively after the talk.

The sample were asked if they thought it acceptable that scanning the dead was undertaken on the same scanners used to examine the living. Prior to the talk 89% replied "yes" which increased to 96% after the talk. A summary of the descriptive results overall can be viewed in Table 1.

**Table 1**  
Summary of descriptive results in %s.

Question	Answer	BINDT	Pathology
Reaction to autopsy being undertaken on a relative	Accept without question	56	59
	Unhappy but would accept decision	13	4
	Question for the need for it	20	33
	Object/upset to the decision	7	4
Object to an autopsy, even if the decision might go against them	Yes	38	41
	No	53	22
Prefer the CT scan over the autopsy	Pre talk – Yes	89	41
	Post talk – Yes	80	33
Prepared to bear the cost of a CT scan	Pre talk – Yes	20	15
	Post talk – Yes	47	11
Reasonable that cost of CT scan fell to relatives	Yes	22	30
	No	78	70
Exact cause of death important	Yes	27	52
	No	38	41

**Table 2**

Themes arising from both groups post talk questionnaires as to the reasons behind the current interest in PMCT scanning replacing invasive autopsies.

Theme	Reasons	
	BINDT sample group	Pathology meeting sample group
Religious beliefs Public perception, respectfulness and family concerns	<ul style="list-style-type: none"> <li>• Religious beliefs and objections to invasive autopsy</li> <li>• To reduce the interference with body after death as it is disrespectful and cause further upset to relatives</li> <li>• Distaste/repulsion of invasive techniques</li> <li>• Organs taken without consent</li> <li>• To prevent organ stealing scams</li> </ul>	<ul style="list-style-type: none"> <li>• Public perception, increased awareness and social pressures</li> </ul>
Financial	<ul style="list-style-type: none"> <li>• Cheaper</li> <li>• Financial interests of radiologist</li> </ul>	
Technological	<ul style="list-style-type: none"> <li>• Best technology simple system with a recordable output that provides more detail and information that can be audited and reviewed at any time</li> <li>• New technology make people enthusiastic about their developments</li> </ul>	
Forensic pathology as an investigation	<ul style="list-style-type: none"> <li>• Increase speed of the investigation</li> <li>• Reduces human subjectivity and increases independence</li> <li>• Job protection</li> <li>• Commercial pressure from equipment manufacturers</li> </ul>	<ul style="list-style-type: none"> <li>• Forensic medical value</li> <li>• Bad press in recent years regarding forensic pathology</li> <li>• Lack of pathologists to do job nationally</li> </ul>
Health and safety		<ul style="list-style-type: none"> <li>• Health and safety issues</li> </ul>

The themes identified from the question asked in the post talk questionnaire as to why the sample believed that there was current interest in using CT scans to replace invasive autopsy in shown in [Table 1](#).

### 3.2. Pathologists

A total of 28 participated in the questionnaire from the pathology meeting. One was excluded due to failure of completion of both parts leaving a sample size of 27 participants. Of these, 44% were male, 48% were female (7% non responders), 25 were pathologist, 1 a coroner and 1 a medical policy advisor. The principle religion was stated as Christian (44%). 100% of responders had experience of an autopsy or the coroners system.

When asked how they would rank their reaction to the thought of an autopsy being undertaken on a relative 59% answered that they would accept this without question, 4% would be unhappy but would accept the decision, 33% would question the need for it to be done, and 4% would be upset with the decision. The pathology group questioned the necessity for an autopsy to be undertaken in the first place, raising the issue that too many unnecessary autopsies were undertaken without good reason in the free text area of the questionnaire.

When asked whether they would object to an autopsy, if they could, even if the decision might go against them, 41% said “yes” and 22% said “no”. There were 37% of no responders. They were then asked, if a CT scan was available as an alternative to an invasive autopsy whether they would prefer the scan over the autopsy prior to the informative talk 41% responded that they would prefer the CT scan although following the talk this was reduced to 33%.

When asked if they would be prepared to bear the cost of the scan which currently can be upwards to £1000, prior to the talk 15% replied “yes” with 30% answering “no” but after the talk 11% replied “yes” and 89% “no”. The increase in those answering “no” reflected the difference between the non-responders to the question before the talk (56%) and after the talk (0%). They were then asked if it was reasonable that the cost of the scan fell to the relatives to which 30% responded “yes” and 70% “no”.

When asked if an invasive autopsy provided “a” cause or “the” cause of death 30% replied “a” and 26% “the” with 44% not answering. When further asked if the exact cause of death was important to them 52% said “yes” and 41% “no”. Finally in this

section, when asked if a CT scan could provide “a” cause of death but not necessarily “the” cause of death would they prefer an autopsy or CT scan, 82% said autopsy and 19% replied the CT scan prior to the talk.

The sample were asked if they thought it acceptable that scanning the dead was undertaken on the same scanners used to examine the living. Prior to the talk 89% replied “yes”. A summary of the descriptive results overall can be viewed in [Table 1](#).

The themes identified from the question asked in the post talk questionnaire as to why the sample believed that there was current interest in using CT scans to replace invasive autopsy in shown in [Table 2](#).

## 4. Discussion

Although we recognise the limitation of this study due to the sample sizes of the two groups being small, in view of the fact that the response level and comments made by both groups independent to each other are similar, then we are of the opinion that the observations made within this paper do give an insight into current pathology/medico-legal practitioners and general public perceptions of the use of CT scanning, for the questions asked, within autopsy practice. Another criticism of the study could be that the general public group were predominately male from a science background. However they arose from a non-medical group with no professional experience of either the autopsy or the coroners system.

The questionnaires highlight commonalities between the two groups. The majority of both groups considered that it was inappropriate for the relatives to pay for a PMCT scan examination which does not appear unreasonable considering that the investigation would be undertaken to assist HM Coroner in determining the cause of death, not the relatives own investigation into said cause. Both groups also agreed that the use of scanners used to examine the living was appropriate for examining the dead. Common themes also arose as to the perceptions as to why there was an interest currently in considering CT scans over invasive autopsies ([Tables 1 and 2](#)).

Where differences arose not all of the results were as the authors might have predicted. Only 7% of the general public sample indicated that if they could they would object to an autopsy being undertaken on a relative if authorised by a coroner. However a larger number of the pathology group questioned the need for an autopsy being undertaken on a relative than the public. If CT

scanning was available as an alternative to the invasive autopsy the public showed an overwhelming desire for this option whereas the pathologist group showed a greater number to be not in favour.

An interesting observation arose from the perception as to whether an autopsy provides “a” cause of death or “the” cause of death. It is understandable that a mixed response is derived from the general public as only 4 of the participants had any experience of an autopsy or the coronial system. However a response of “the” cause of death in only 26% of the pathologist group with a further 44% not answering the question is a surprising observation. The views of the pathology group produced a further surprise by the observation that 41% of this group considered that they would be satisfied with a “reasonable” cause of death, not the “exact” cause of death. This is especially surprising as the question as to accuracy of the cause of death provided by a CT scan is often raised in the authors experience by pathologists as a reason why CT scanning may not be suitable to replace the invasive autopsy. With an insight into CT scanning of cadavers as given in the talks the general public preferred the option of a CT scan knowing that radiological imaging may provide “a” cause, not “the” cause of death. Despite the considerations of the pathologists in relation to the cause of death derived from an autopsy, the pathology group still preferred an invasive autopsy over to a CT scan. With these observations in mind it demonstrates that the public do not appear to be overly concerned over the accuracy of the cause of death and the pathology group does not appear concerned that the true cause is not provided.

## 5. Summary

We present for the first time to our knowledge an insight into pathologist/medico-legal practitioners and general public perceptions concerning the use of CT scanning as an alternative to the invasive autopsy. The results show commonalities between the two groups with a desire from the public to use this investigation if

available. The pathology group however expressed the desire for an invasive autopsy over a CT scan.

### Ethical approval

None declared.

### Funding

None declared.

### Conflict of interest

None declared.

## Acknowledgements

We thank the organisers and participants of the two meetings from this paper for assisting us with the completion of the questionnaires.

## References

1. Rutty JE. Religious attitudes to death and post-mortem examinations. In: Burton JL, Rutty GN, editors. *The hospital autopsy. A manual of fundamental autopsy practice*. 3<sup>rd</sup> ed. London: Hodder Arnold; 2010. p. 39–58.
2. Rutty GN. Are autopsies necessary? The role of computed tomography as a possible alternative to invasive autopsies. *Rechtsmedizin* 2007;**17**:21–8.
3. Kranz P, Holtas SJ. Postmortem computed tomography in a diving fatality. *Comput Assist Tomogr* 1983;**7**:132–4.
4. Donchin Y, Rivkind AI, Bar-Ziv J, Hiss J, Almog J, Drescher M. Utility of post-mortem computed tomography in trauma victims. *J Trauma* 1994;**37**:552–6.
5. Thali MJ, Yen K, Schweitzer W, Vock P, Boesch C, Ozdoba C, et al. Virtopsy, a new imaging horizon in forensic pathology: virtual autopsy by post-mortem multislice computed tomography and magnetic resonance imaging: a feasibility study. *J Forensic Sci* 2003 Mar;**48**(2):386–403.
6. O'Donnell C, Woodford N. Post-mortem radiology—a new sub-speciality? *Clin Radiol* 2008;**63**:1189–94.
7. Traill Z. The role of computed tomography and magnetic resonance imaging in the investigation of natural death. *Diagn Histopathology* 2010;**16**:560–4.
8. Rutty GN. High throughput adult cadaver axial imaging: service logistics and requirements. *Diagn Histopathology* 2010;**16**:573–7.